OPTICAL DEVICES FOR MEDICAL DIAGNOSTICS

5   CLAIMS

We claim:

1. A method for diagnosing disease in a patient comprising:

     a. generating data for Raman, fluorescence, and diffuse reflectance spectra and images for a selected tissue of the patient;

10   b. providing data as a spectral library of tissue database classified by normal and diseased tissue for Raman, fluorescence and diffuse reflectance spectra and images for the same type of tissue; and

     c. performing classification decisions to detect and identify diseased tissue by comparing the generated data from step a with the provided data in

15 step b.

2. The method according to claim 1, with the additional step of:

     d. displaying image and/or data results perceptible to a user as to the identification of the state of disease for the patient's selected tissue.

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3. The method according to claim 1, wherein the generated data of step a is obtained by biopsy or direct optical measurement of the patient's tissue.

4. The method according to claim 1, wherein the data for the spectral library

25 is developed from biopsy (ex vivo) or direct measurement (in vivo).

5. The method according to claim 1, comprising

     (1). fusing the generated data for Raman, fluorescence, and diffuse reflectance of step a; and

30   (2). fusing the provided data for Raman, fluorescence, and diffuse reflectance of step b;

     wherein the fusing steps are performed prior to performing the classification decisions of step c.

6. The method according to claim 1, wherein time gating is used to reduce interferences from surface scattering and/or to reduce or remove interferences between Raman and fluorescence measurements.

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7. The method according to claim 1, wherein time gating is used for depth profiling below the surface of tissue.

8. A method for diagnosing disease in a patient comprising:

10   a. generating illumination light for Raman, fluorescence, and diffuse reflectance measurements;

b. illuminating a region of selected tissue of a patient with the light generated in step a;

c. generating data for Raman, fluorescence, and diffuse reflectance

15   spectra and images from the illumination of selected tissue of the patient;

d. providing data as a spectral library of tissue database classified by normal and diseased tissue for Raman, fluorescence and diffuse reflectance spectra and images for the same type of tissue; and

e. performing classification decisions to detect and identify diseased

20   tissue by comparing the generated data from step c with the provided data in step d.

9. The method according to claim 8, with the additional step of:

f. displaying image and/or data results perceptible to a user as to the

25   identification of the state of disease for the patient's selected tissue.

10. The method according to claim 8, wherein the generated data of step a is obtained by biopsy or direct optical measurement of the patient's tissue.

30   11. The method according to claim 8, wherein the data for the spectral library is developed from biopsy (ex vivo) or direct measurement (in vivo).

12. The method according to claim 8, comprising

(1). fusing the generated data for Raman, fluorescence, and diffuse reflectance of step c; and

(2). fusing the provided data for Raman, fluorescence, and diffuse reflectance of step d; wherein the fusing steps are performed prior to performing the classification decisions of step e.

13. The method according to claim 8, wherein time gating is used to reduce interferences from surface scattering and to reduce or remove interferences between Raman and fluorescence measurements.

14. The method according to claim 8, wherein time gating is used for depth profiling below the surface of tissue.

15. Apparatus for identifying and detecting the disease state of a patient's selected tissue comprising:

a. means for generating light adapted to generate Raman, fluorescence, and diffuse reflectance spectra and images for a selected tissue of the patient;

b. means for illuminating a region of a patient's tissue with the generated light;

c. means for collecting light emanating from the illuminated tissue;

d. means for providing Raman, fluorescence, and diffuse reflectance spectra and images in the collected light;

e. a spectral library of Raman, fluorescence, and diffuse reflectance spectra and images representative of normal and diseased tissue; and

f. a computer system for controlling light generation in a above, and detection and classification of the patient's tissue based on information from the means for detecting, and the spectral library.

16. Apparatus according to claim 15, comprising:

    (g). means for displaying data and/or images from the computer system, perceptible to a user as to the identification of the state of disease for the patient's selected tissue.

17. The apparatus according to claim 15, comprising

    (1). means for fusing the Raman, fluorescence, and diffuse reflectance spectra and images of means d; and

    (2). means for fusing the spectral library Raman, fluorescence, and diffuse reflectance spectra and images; wherein the means for fusing are prior to the computer system performing the classification decisions.

18. The apparatus according to claim 15, comprising means for time gating data to reduce interferences from surface scattering and/or to reduce or remove interferences between Raman and fluorescence measurements.

19. The apparatus according to claim 15, means for time gating for depth profiling below the surface of tissues.

20. Diagnostic device comprising:
apparatus including means for Raman, fluorescence and transflectance measurements, means for data computation, and means for display perceptible to a user for the detection and identification of disease.